Prevention of Significant Deterioration Implementation Analysis and Sulfur Dioxide Increment Consumption Assessment Summary

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The North Dakota Department of Health has implemented the Prevention of Significant Deterioration (PSD) program since 1976. The Department has permitted a number of new sources under the program including coal-fired electrical generating plants, natural gas processing plants, and others. Since the early 1980's, computer dispersion modeling has indicated exceedances of the PSD Class I increments for sulfur dioxide. Although computer dispersion modeling predicted exceedances, the Federal Land Managers for the Class I areas have certified that the emissions from proposed facilities would not have an adverse impact on air quality related values in the Class I areas. In accordance with the variance procedures in the PSD rules (NDAC 33-15-15-01.4.j(4)), the Department issued permits to several new sources without objection from the Environmental Protection Agency.

In a February 1, 2000 letter, the U.S. Environmental Protection Agency (EPA's), suggested that the State should have revised the PSD portion of the State Implementation Plan to correct any predicted increment violation. This determination was made despite the certifications of no adverse impact by the Federal Land Managers and permitting of sources under options provided by previous and current PSD rules.

In response to EPA, the Department has performed a legal analysis of the Clean Air Act and PSD rules to determine the appropriate method of implementing the PSD program. Based on this legal determination, the Department has evaluated and proposed values for the baseline emission rates for eleven major facilities and oil and gas wells. The emission rates were then used to conduct computer dispersion modeling to assess the amount of increment consumed in the Class I areas. A summary of the findings of these analyses follow.

Legal Analysis

A legal analysis was performed in response to EPA's letter of February 1, 2000 to identify issues surrounding the assessment of increment under the Prevention of Significant Deterioration Rules. A summary of the legal analysis is provided and is identified as "Summary of Legal Procedure and Summary of Legal Issues relating to Administration of the Prevention of Significant Deterioration (PSD) Provision of North Dakota's State Implementation Plan (SIP).

Baseline Emission Rates

When establishing the amount of emissions that contribute to the baseline concentration, the Department has determined that a facility's actual operating hours, production rates, and the types of materials processed or combusted should be considered. The time period during which these emissions occurred will generally be the two years prior to the minor source baseline date for sulfur dioxide (December 19, 1977). However, a different time period may be used, provided it is more representative of normal operations. The emission rate for the applicable averaging periods (i.e., 3-hr, 24-hr, and annual average) must be based on the average annual emissions divided by the hours of operation.

The method for determining normal operations for a source is not defined in the Prevention of Significant Deterioration rules and the Department found no air pollution control related guidance on the subject. The Department developed criteria for determining normal operations for the variety of sources that contributed to the baseline concentration. The source categories included coal-fired utility boilers, natural gas processing plants, petroleum refineries, oil and gas operations and a charcoal briquetting plant. These are all distinctly different sources; however, the Department proposes that the determination of normal operations for each category can be based on similar criteria. That is, normal operations can be defined by processing rates or fuel combustion rates for all source categories. The Department proposes that normal operations are independent of emissions from the facility. Since the sulfur content of the material processed (e.g., sour natural gas, petroleum, and coal) or fuel combusted (e.g., oil, coal, or fuel gas) can vary, the sulfur dioxide emissions can vary without a change in production rate. This change in fuel quality or material processed is generally a function of the place of origin of the material. The quality of fuel combusted or material processed may affect production rates to a certain extent, however, normal operations of the plant are more affected by the design of the plant, the demand for the final product (electricity, natural gas, charcoal briquettes, etc.) and the availability of the material to be processed.

The Department proposes that a time period from 1975-80 be used to establish normal operations for facilities that contribute to the baseline concentration. Where increases in the value used for determining normal operations could have been reasonably anticipated on the minor source baseline date, adjustments were made that take into account these anticipated increases in production when calculating emissions that contribute to the baseline concentration.

The Department proposes that normal operations for existing coal-fired electric utility boilers be based on the heat input to the unit per hour of operation. The data for calculating the heat input and hours of operation was taken from the Annual Emission Inventory Reports that were submitted for the facilities. The Department calculated and reviewed this value for each facility for the data that was available. Based on the review, it is proposed that the 1975-80 time period contains a two-year period that is representative of normal operations for the coal-fired utility boilers. The emissions that contribute to the baseline concentration were generally calculated based on the highest two-year period within the 1975-80 period. Because changes in the sulfur content (increases and decreases) of the coal that was burned may have been anticipated, the Department proposes that the mine average sulfur content be used in the calculations. For those sources that switched sources of the coal combusted, the average sulfur content was calculated for the mine which supplied the coal on the minor source baseline date.

All other source categories were evaluated independently. However, the 1975-80 time period was also used for determining normal operations. Where production data was not available, the two-year period immediately preceding the minor source baseline date (1976-77) was generally used to calculate the emission rate that contributed to the baseline concentration. Again, where evidence of impending production increases were evident on the minor source baseline date, these increases were taken into account when calculating the emission rate that contributed to the baseline concentration.

The Department evaluated different methods for establishing the emission rate that is used to establish the baseline concentration. These included emission factors, stack test data, continuous emission monitor data, and a chemical mass balance approach. Emission factors from AP-42, Compilation of Air Pollutant Emission Factors, were used to calculate the emission rate for coal-fired electric utility boilers. No adjustment to the average emission factor, 30(s), was made. It was determined that there was insufficient data (e.g., coal ash sodium content) at the time the analysis was completed to warrant any adjustment. If additional data is provided which justifies a different factor, changes to the emission rates should be made. For the other source categories, emission rates were generally calculated based on a mass balance approach or stack test data.

The results of the analysis and more detailed information is presented in the document “Prevention of Significant Deterioration, Sulfur Dioxide Baseline Emission Rates”.

Calpuff Modeling

The North Dakota Department of Health (Department) has conducted an air quality modeling analysis to determine the current status of Prevention of Significant Deterioration (PSD) Class I increment consumption for sulfur dioxide (SO_2) in North Dakota and eastern Montana. This analysis is described in "Calpuff Analysis of Current PSD Class I Increment Consumption in North Dakota and Eastern Montana using Actual Annual Average SO_2 Emission Rates."[1]

The Department considered a number of alternatives for the modeling protocol before arriving at this final iteration. Alternatives dealt primarily with the characterization of SO_2 emission rates, and the interpretation of model output. Basic modeling methodology, including processing of meteorological data and Calmet/Calpuff input settings, is considered technically sound, and remained constant during the investigation of alternative protocols.

Features of the current analysis include the use of annual average actual emission rates (i.e., average over hours of operation), five years of meteorological data, receptor averaging to provide uniform predictions for each Class I area, and modeling of complete baseline and current emission inventories to determine increment consumption. The Department also completed an earlier modeling iteration using alternative CEM (continuous emission monitoring) hourly emission rates. This alternative is described in "Calpuff Analysis of Current PSD Class I Increment Consumption in North Dakota and Eastern Montana using CEM hourly SO_2 Emission Rates Coupled with Concurrent Meteorology".[2]

Implementation of the Calpuff model for the current analysis followed EPA and IWAQM (Interagency Workgroup on Air Quality Modeling) guidance, including the use of five years of conventional meteorological data. Based upon a legal review and analysis of the Prevention of Significant Deterioration law and subsequent rule making, the Department used a non-traditional approach in the interpretation of model output to determine Class I increment compliance. This approach involved determining a fixed

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[1]NDDH, April 2002. Calpuff Analysis of Current PSD Class I Increment Consumption in North Dakota and Eastern Montana using Actual Annual Average SO_2 Emission Rates. North Dakota Department of Health, Bismarck, ND 58506.

[2]NDDH, March 2002. Calpuff Analysis of Current PSD Class I Increment Consumption in North Dakota and Eastern Montana using CEM Hourly SO_2 Emission Rates Coupled with Concurrent Meteorology. North Dakota Department of Health, Bismarck, ND 58506

modeled baseline concentration, adding the allowable increment (i.e., 25 $\mu g/m^3$ for 3-hour, 5 $\mu g/m^3$ for 24-hour average) to the baseline concentration to establish a MAAL (Maximum Allowable Ambient Level), and then comparing the modeled results for the current (Year 2000/2001) source inventory against the MAAL. The approach also incorporated the use of receptor averaging to provide a uniform prediction for each Class I area.

As part of the Class I area increment analysis, the Department conducted a model performance evaluation to determine the effectiveness of Calpuff in reproducing SO_2 concentrations observed at monitoring sites in North Dakota. The performance evaluation also served as the basis to "tune" model input (control file) settings to provide optimal agreement between predictions and observations. As a result of the evaluation and tuning process, some of the input settings utilized by the Department differ from those recommended by IWAQM.

Results of the current Calpuff analysis, utilizing annual average actual emission rates, demonstrate compliance with PSD Class I increments for SO_2.